

‘Structure Formation’: An Analysis of Electronic Superimpositions in Stockhausen’s *Solo*

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Abstract

In his work *Solo für Melodieinstrument mit Rückkopplung, n° 19* (*Solo for Melody Instrument with Feedback*), Karlheinz Stockhausen employs a variable length tape delay and feedback system to record and play back the material of the soloist live, creating layers of superimposed electronic sound. It is this structure of electronic superimpositions which will be the focus of analysis. I will begin by examining and creating a nomenclature for electronic superimpositions, which form patterns and manifest techniques that evolve across complete and partial cycles (sections). In an attempt to prove an overall structure of electronic form, I will present a topology of these patterns and techniques that demonstrates a systematic organization of elements. Although *Solo* appears to be an open-form work, electronic superimpositions manifest structures which function at a macro-formal level, whereas content (and a number of other parameters) shape form at a micro-formal level. Thus, *Solo* has a definite fixed form: a structure of electronic superimpositions which Stockhausen systematically conceives and distributes across the six Versions of the work.

Introduction

I imagined a music in which – as in life – at certain moments splinters or figures of memory simultaneously superimpose audibly, to which the soloist could play commentaries, supplements, something new: a music in which one senses that the player is ‘thinking out loud’, and in which one experiences the creation and dissolution of multi-layered processes, as they take place. Only when music makes us aware of the polydimensional thinking and experiencing and of the process of the structure formation – instead of an object – a higher level of composing for a soloist would be achieved.¹

Karlheinz Stockhausen, in his work *Solo for Melody Instrument with Feedback*, sought a new conception of form, a ‘memory’ form in which a feedback of musical ideas would interact in realtime. The creation of the score itself follows an interactive process whereby the instrumentalist extracts fragments from Stockhausen’s pre-composed musical material and patches them together anew. A performance of *Solo* incorporates a tape delay and feedback system that superimposes recorded material and plays it back live. It is this ‘structure formation’ of electronic superimpositions which will be the focus of analysis. Although *Solo* appears to be an open-form work, electronic superimpositions manifest structures which

¹ Karlheinz Stockhausen, *Programm zu den Interpretations und Kompositionskursen und Konzerten der Musik von Stockhausen 27 Juli bis 4 August 2002 in Kürten*, 50.

function at a macro-formal level, whereas content (and a number of other parameters) shape form at a micro-formal level. Thus, *Solo* has a definite fixed form: a structure of electronic superimpositions which Stockhausen systematically conceives and distributes across the six Versions of the work.

Stockhausen created six Versions of *Solo*; each Version comprises six Cycles, or sections, labelled from A to F, and each Cycle is further divided into a number of Periods, or subsections, ranging between six and eleven. Periods function as the temporal structure on which superimpositions form and range in length from six seconds to 45.6 seconds. Stockhausen provides a ‘Form Scheme’ for each Version, which specifies the number and duration of Periods in every Cycle and includes instructions for the application of the feedback and the output of sound.

I	II	III	IV	V	VI
10'39.8"	12'49"	15'25.9"	15'25.9"	17'16"	19'5"
(639.8s)	(769s)	(925.9s)	(925.9s)	(1036s)	(1140s)

Cycles
(Repetitions x Duration of Periods in Seconds)

	A	B	C	D	E	F
I	11 x 6s	8 x 14.2s	7 x 19s	6 x 25.3s	9 x 10.6s	10 x 8s
II	9 x 12s	7 x 24s	11 x 6s	10 x 8.5s	6 x 30.4s	8 x 17.1s
III	7 x 30.4s	10 x 9s	8 x 20.25s	9 x 13.5s	11 x 6s	6 x 45.6s
IV	6 x 45.6s	11 x 6s	9 x 13.5s	8 x 20.25s	10 x 9s	7 x 30.4s
V	8 x 22.8s	6 x 45.6s	10 x 11.4s	11 x 8s	7 x 32s	9 x 16s
VI	10 x 14.2s	9 x 19s	6 x 45.6s	7 x 34.2s	8 x 25.3s	11 x 10.6s

} Retrograde

Figure 1: Duration of the Six Versions of *Solo*

To produce the electronic superimpositions, Stockhausen employs a variable length tape delay (consisting of six different delay times) in combination with a feedback circuit. Three assistants open and close potentiometers at precise times, controlling both input and output. The diffusion of sound is monophonic; the two channels are used to increase the combinational possibilities of superimpositions. Stockhausen’s feedback system, unique for its time, allows for a surprisingly vast array of superimposed structures, but has its limitations as well.

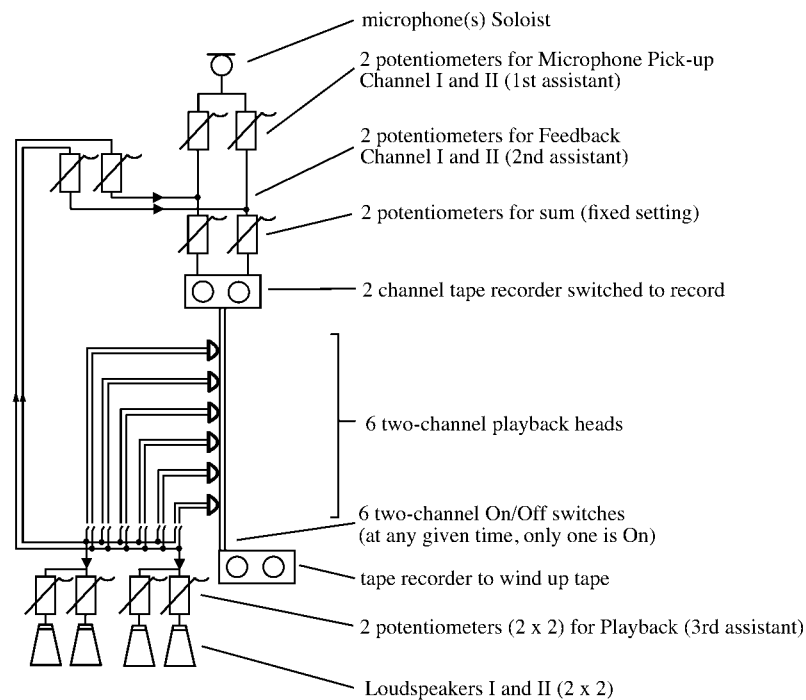


Figure 2: Schematic Diagram of the Technical Set-up²

Although the Feedback Schemes provide precise instructions for the assistants, they do not present a clear visual image of electronic superimpositions. Therefore, I have transferred the data from the Feedback Schemes of all Versions onto a set of Superimposition Graphs (Appendix I). These graphs combine acoustic and electronic periods without a visual division of channels, thereby providing the clearest representation of the actual structure of superimpositions within *Solo*.

Before moving on to the analysis, I will define two key terms. The first, electronic rests, I define as the absence of output from the feedback system from both Channel I and II. Throughout *Solo*, electronic playback predominates; however, Stockhausen often places electronic rests at the beginning and the end of Cycles. Thus, electronic rests play an important role in defining form by setting off Cycles from one another. The second term, electronic canon structure, refers to the electronic playback of an acoustic period in the immediately subsequent Period. Canon structure predominates in all Versions and serves two main purposes: maintaining a sense of unity and building accumulation structures. This leads us to the analysis, where we will examine the use and placement of electronic material.

Analysis of Electronic Superimpositions and Techniques

Studying the Superimposition Graphs, it becomes immediately evident, visually, that certain logical and often symmetrical superimposition patterns exist within cycles. In order to describe and categorize these patterns, I have devised a terminology relating to how such structures might be perceived aurally. In addition to these patterns, I will discuss what I refer to as a Complete Cycle Drone.

² Stockhausen, *Nr. 19, Solo für Melodieinstrument mit Rückkopplung*, 15.

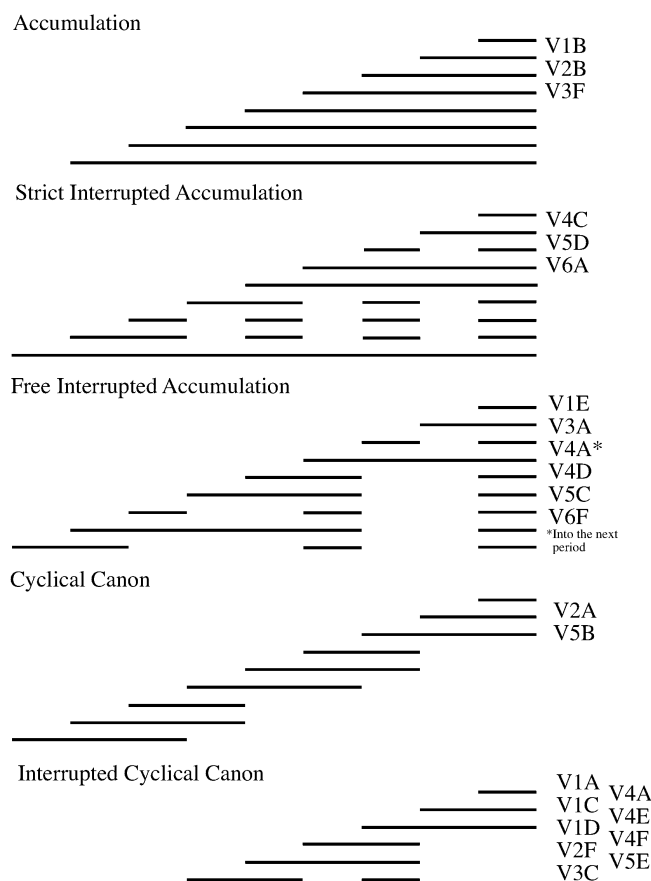


Figure 3: Visual Characteristics of Complete Cycle Superimposition Patterns

However, it is important to note that the material in the Superimposition Graphs is not an exact representation of actual electronic output; perforations (the rapid closing and reopening of the potentiometers), acoustic pauses, and acoustic entry types may alter, to a varying degree, the output of electronic material. As well, for now, we will ignore feedback from previous Cycles which carries into the following Cycle.

The first superimposition pattern, Accumulation, utilizes the full capabilities of Stockhausen's feedback system. The effect of such a structure is musically unique: in the case of V1B (Version I Cycle B), it would be analogous to eight layers of *ostinati*. But full accumulation could prove overwhelming to a listener. The use of canons in the first few periods of a cycle may aid in creating a coherent, unified musical texture, but most likely from the fifth period on, any such effect would be nullified due to the fact that the human brain is not capable of processing so many musical layers. At a certain point, individual superimpositions might no longer be discernible; instead, the listener would only perceive a change in musical content as superimpositions would blend into a chaotic whole. This effect could be advantageous to a composer as a unique means of development; however, Stockhausen mostly avoids these inherent musical pitfalls by employing Accumulation in only a few instances and in Cycles with a relatively lower number of periods.

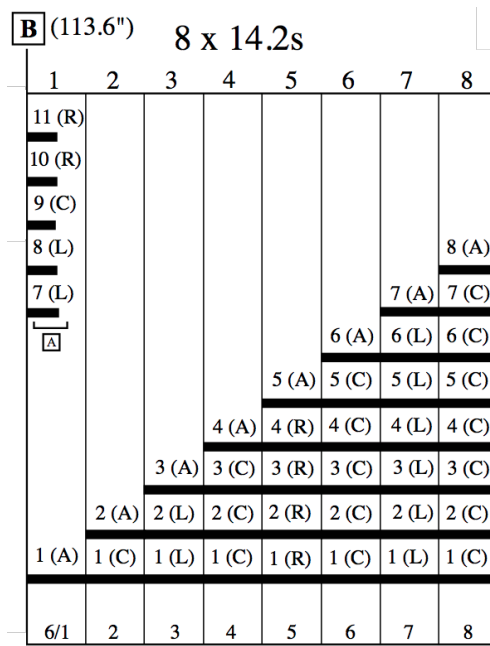


Figure 4: Example of Accumulation (V1B)

Stockhausen makes use of two variations of Accumulation. The first is Strict Interrupted Accumulation, which alternates full accumulation with sub-accumulation on successive periods beginning in the fourth or fifth period. Additionally, sub-accumulation follows a consistent logical pattern, and the final period always reaches full accumulation.

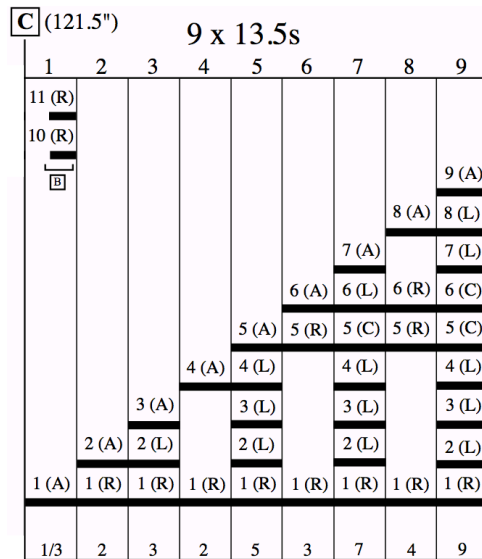


Figure 5: Example of Strict Interrupted Accumulation (V4C)

The second variation, Free Interrupted Accumulation, is a less strict version of its counterpart in which interruptions do not necessarily alternate on successive periods and in which sub-accumulation does not necessarily follow a logical pattern.

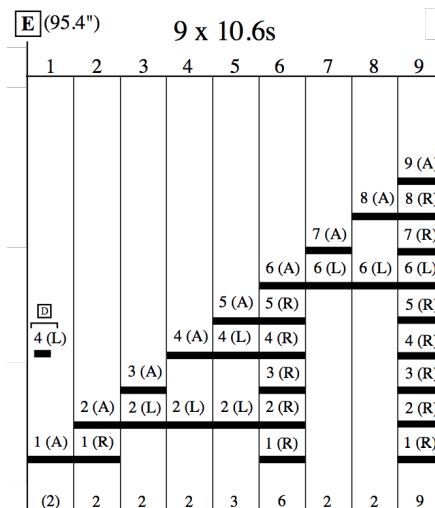


Figure 6: Example of Free Interrupted Accumulation (V1E)

The two Interrupted Accumulation Patterns offer the listener a respite from the possibly static structure of Accumulation by including variation. Most likely as a result, Stockhausen includes more occurrences of the latter pattern.

The next pattern I will discuss, the Cyclical Canon, I define as a continuous series of canons that cycle within a relatively sparse texture. Although Cyclical Canons must be complete canon structures, complete canon structures do not by definition result in cyclical canons. Most other complete canon structures result in some type of accumulation pattern, with the exception of V4F, which forms the next pattern we will consider.

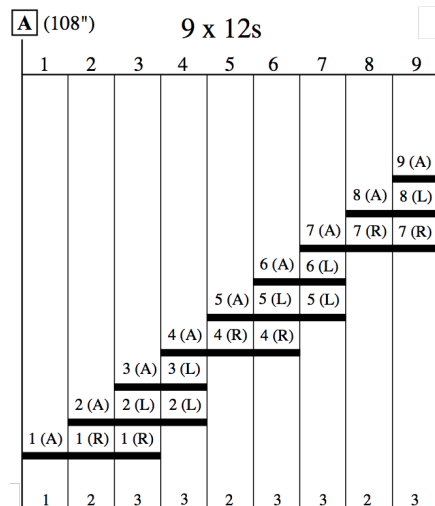


Figure 7: Example of the Cyclical Canon (V2A)

The Interrupted Cyclical Canon is a less strict version of the Cyclical Canon in which acoustic periods do not necessarily have to form canons, yet most periods still do. As well, repeated periods are sometimes interrupted for a single period and return in the next period.

As with Cyclical Canons, the texture consists of between two to three layers, yet occasionally, and only for a single period, the texture may increase to four layers.

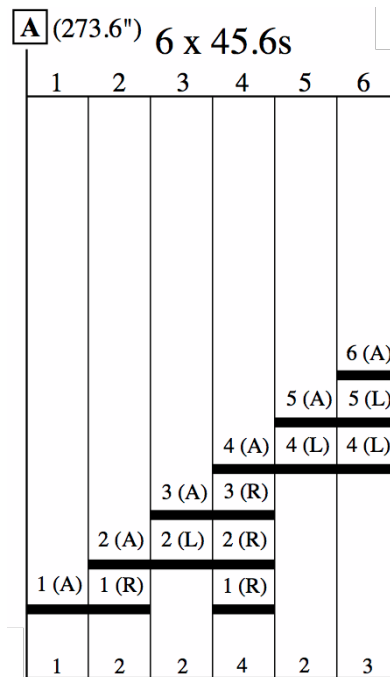


Figure 8: Example of the Interrupted Cyclical Canon (V4A)

Cyclical Canons and variations thereof provide the listener with an anchor to guide their listening, somewhat analogous to the experience of traditional contrapuntal music. As well as providing an anchor, Interrupted Cyclical Canons engage the ear by varying the texture: the number of layers fluctuates and the composition of layers changes in much less a predictable pattern than with Cyclical Canons.

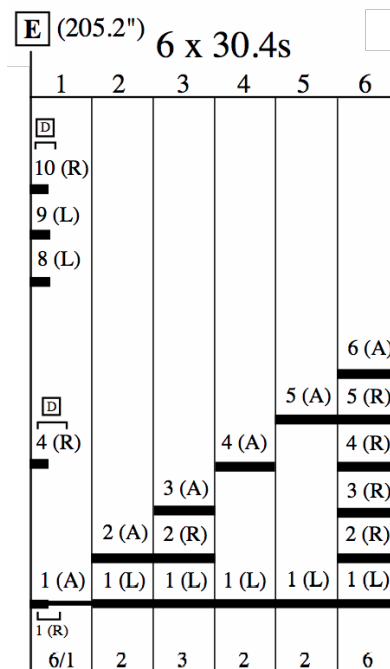


Figure 9: Example of the Complete Cycle Drone (V2E)

Finally, we will consider the Complete Cycle Drone, which I define as a period (or periods) that repeats for an entire cycle. The first or second period must form the drone, so the drone is able to establish itself as an entity within a Cycle. As well, in order for the listener to perceive a drone, it must mainly occur within a relatively sparse texture. The musical effect of Drones depends largely on their content: repetition of a period containing a single tone results in a drone effect, but various types of melodic or rhythmic *ostinati* could also be formed. All the aforementioned superimposition techniques occur within partial cycles as well. A number of other techniques occur exclusively in partial Cycles, for example Deaccumulation and Chordal Blocks, which we will examine now.

Chordal Blocks span a full or partial period and involve the sudden addition of two or more electronic layers to a period. Accordingly, Chordal Blocks contain a minimum of three layers including the acoustic period, but more often they contain a greater number of layers. As well as the sudden addition of layers, a sudden subtraction of layers most often, though not necessarily, follows Chordal Blocks. However, Chordal Blocks may also be followed by a decrease of just a single layer, an increase of a single layer (at most), or a voice exchange. Stockhausen makes frequent use of Chordal Blocks (more than any other superimposition technique), and they often appear more than once within a single cycle.

Chordal Blocks fall into two categories: Structural Chordal Blocks and Cadential Chordal Blocks. The first category includes Chordal Blocks which are subsumed within the process of Interrupted Accumulation Patterns and Interrupted Cyclical Canons. These Chordal Blocks create variety within the texture, but at the same time tend to blend in with the textural development taking place and do not, in themselves, play an important formal role; however, the second category of Chordal Blocks do, as they serve mainly to mark divisions between cycles. This fact is important because an inherent formal musical division between cycles does not necessarily exist.

D (88")

11 x 8s

	1	2	3	4	5	6	7	8	9	10	11
											11 (A)
C										10 (A)	10 (L)
9 (R)									9 (A)	9 (R)	9 (L)
8 (C)								8 (A)	8 (L)		8 (L)
7 (R)							7 (A)	7 (R)	7 (L)	7 (R)	7 (L)
6 (R)					6 (A)	6 (L)			6 (L)		6 (L)
5 (R)				5 (A)	5 (R)	5 (L)	5 (R)	5 (L)	5 (R)	5 (L)	5 (L)
4 (R)			4 (A)	4 (L)			4 (L)		4 (L)		4 (L)
3 (L)		3 (A)	3 (R)	3 (L)	3 (R)	3 (L)	3 (R)	3 (L)	3 (R)	3 (L)	3 (L)
2 (R)	2 (A)	2 (L)		2 (L)		2 (L)		2 (L)		2 (L)	2 (L)
1 (R)	1 (R)	1 (L)	1 (R)	1 (L)	1 (R)	1 (L)	1 (R)	1 (L)	1 (R)	1 (L)	1 (L)
1 (A)											
10/1	2	3	3	5	4	7	5	9	6	11	

Figure 10: Example of a Structural Chordal Block (V5D)

The vast majority of Cadential Chordal Blocks occur in either the first period or the final period of cycles and act as markers of form by emphasizing the formal division between cycles, mainly by virtue of a sudden change in texture. Stockhausen's use of Chordal Blocks, and especially Cadential Chordal Blocks, play an important role in defining form and are probably the most readily recognizable superimposition technique, as well as the most frequently used.

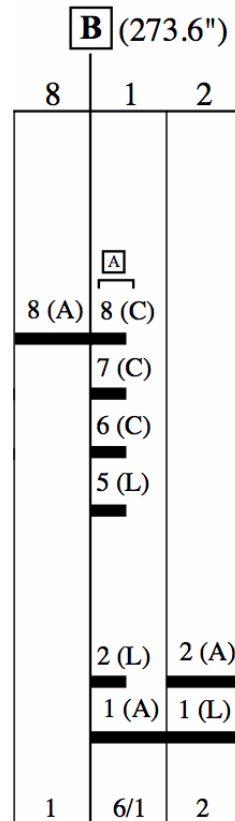


Figure 11: Example of a Cadential Chordal Block (V5B)

Next we will consider Deaccumulation, which involves a reduction of layers over a partial period, a single period, or a number of periods; however, I will not classify a reduction of layers following a Chordal Block as Deaccumulation. As well, Deaccumulation mainly involves the reduction of a single layer per period and at most two layers per period. Due to the nature of Stockhausen's feedback system, a reduction of layers can only occur after an accumulation of layers; therefore, Deaccumulation occurs mid-cycle or later.

To a certain extent, Deaccumulation serves to balance the aural effect of Accumulation; but Stockhausen's feedback system is limited in that the maximum possible span of Deaccumulation is five periods. As well, Stockhausen achieves accumulation through a natural process (which simply involves leaving the microphone, feedback, and output levels open). The manifestation of Deaccumulation, on the other hand, is much less straightforward and involves specific manipulation of the feedback system, which is the main reason accumulation processes dominate throughout *Solo*.

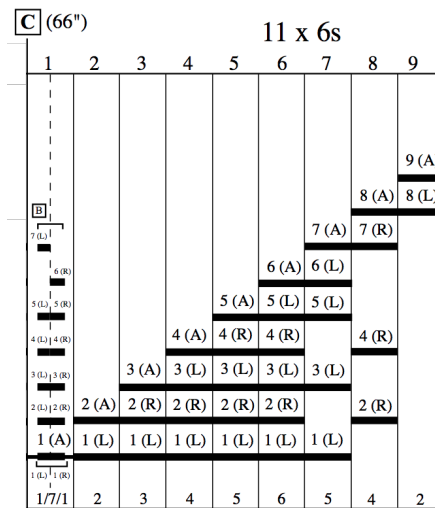


Figure 12: Example of Deaccumulation (V2C)

I have presented and endeavoured to categorize a list of superimposition patterns and techniques which recur across cycles, and as we have seen, certain patterns do recur and certain techniques are common among versions. Thus, the use of electronic superimposition structures across cycles employs recognizable techniques and patterns. In addition, superimposition patterns predominately exist within a single cycle, only occasionally extending into the following cycle, but in no instances do patterns exist over the span of two or more cycles. As a result, superimposition patterns mark the boundaries of cycles, along with Cadential Chordal Blocks and electronic rests, and establish cycles as independent formal entities.

Topology of Superimposition Patterns Title of Section 2

Having categorized the various superimposition techniques at Stockhausen's disposal, we will now turn to an analysis of their use. In Figure 13, I have condensed the various subcategories of superimposition techniques down to their basic elemental patterns (Canon and Accumulation) and have labelled cycles not displaying a single uniform pattern as Mixed.

	A	B	C	D	E	F
V1	Canon	Accumulation	Canon	Canon	Accumulation	Mixed
V2	Canon	Accumulation	Mixed	Mixed	Accumulation	Canon
V3	Accumulation	Mixed	Canon	Mixed	Mixed	Accumulation
V4	Canon	Mixed	Accumulation	Accumulation	Canon	Canon
V5	Mixed	Canon	Accumulation	Accumulation	Canon	Mixed
V6	Accumulation	Mixed	Mixed	Mixed	Mixed	Accumulation

Figure 13: Condensed Topology of Superimposition Techniques

Stockhausen distributes the three condensed patterns types fairly evenly across cycles. As well, all Versions, except V6, contain at least one cycle of all three condensed pattern types. Furthermore, from V1 to V5 Stockhausen mainly intersperses pattern types, for the most part avoiding consecutive fixed patterns. The alternation of fixed pattern types creates formal variety. Only V6 does not follow an alternating pattern as it begins and ends with Accumulation and the inner cycles are all Mixed; however, it still follows the same principle of formal variety.

A Systematic Allocation of Superimpositions: Layer Density Patterns

Although the analysis of complete cycle Superimposition patterns and techniques does not point to an entirely systematic organization, Stockhausen did conceive a precise system to determine and allocate superimpositions. In a sketch of electronic form³, Stockhausen organizes superimpositions into six groups, apparently on the basis of layer density patterns, and systematically disperses these patterns across the six Versions of *Solo*.

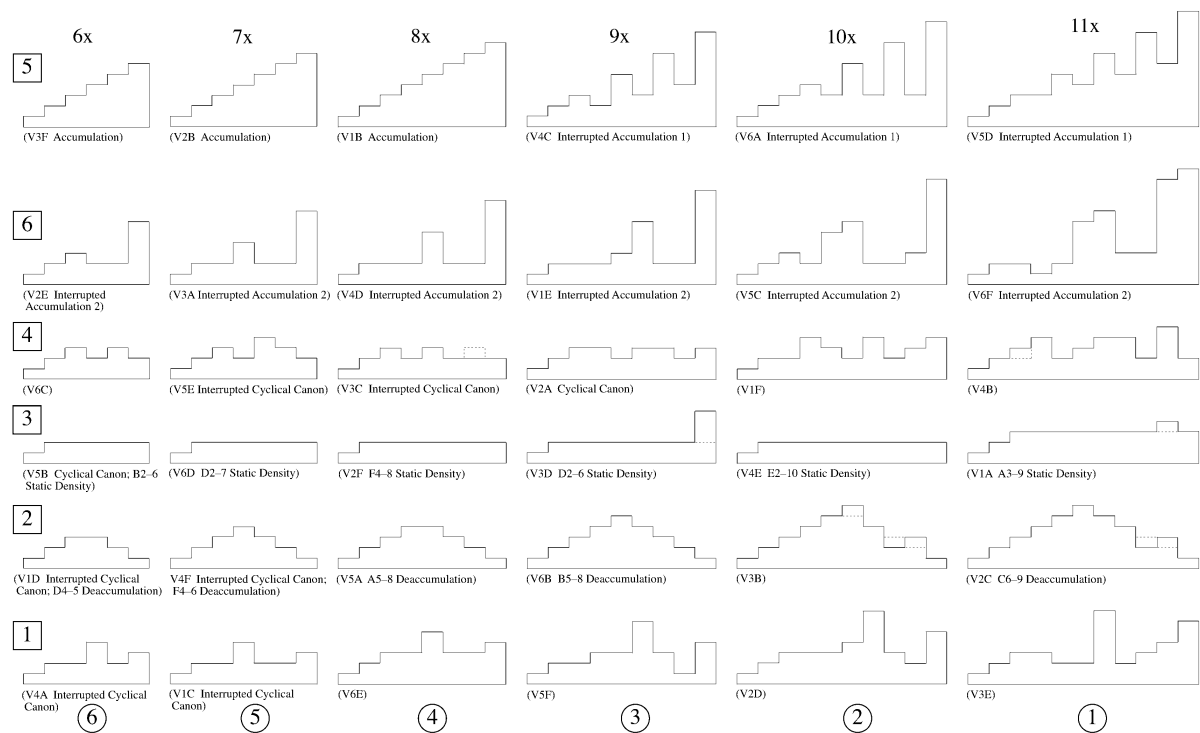


Figure 14: Stockhausen's Layer Density Patterns

In Figure 14, I have transcribed the schematic of layer density patterns from Stockhausen's sketch. Stockhausen groups the layer density patterns into six categories each displaying similar characteristics. Group five consists of accumulation structures: the first three patterns display full accumulation and the remaining three display interrupted accumulation; all patterns end with full accumulation. Group six patterns also display accumulation structures ending with full accumulation, but the density of overall accumulation is lower than in group five and is not systematic. Group four patterns reach accumulation of approximately half the total layers; the first two patterns involve two nearly equal points of accumulation and the

³ Stockhausen, *Text zur Musik 1963-1970*, 88-89.

remaining patterns involve three equal (or nearly equal) points of accumulation. Group three patterns accumulate to a point of static density of two layers in the case of the first five patterns and of three layers in the final case. Group two patterns all involve a symmetrical accumulation and deaccumulation structure. Finally, group one patterns involve an accumulation to a peak point in the middle of the cycle followed by deaccumulation and then accumulation to another lesser point.

The dispersion of layer density patterns across Versions follows a process which incorporates symmetry, logic, and a number of arbitrary decisions on the part of Stockhausen; I have illustrated this process in the following slide. Thus, Stockhausen did have in mind a systematic method of deriving and allocating superimpositions; however, deviations from Stockhausen's sketch and the later addition of partial periods somewhat obscure the original conception of superimpositions.

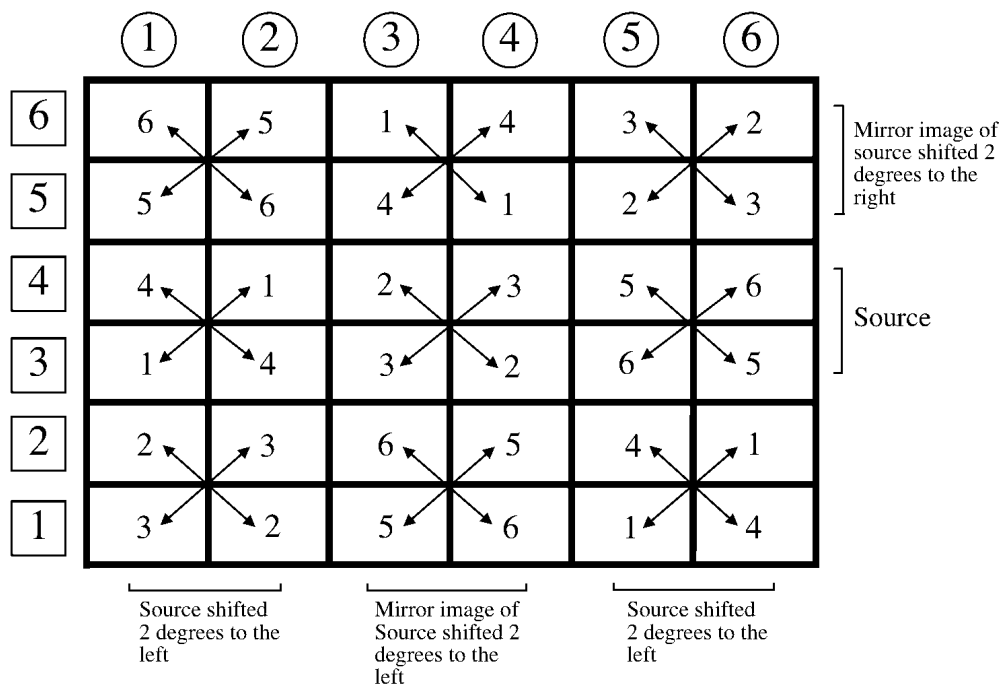


Figure 15: Dispersion of Layer Density Patterns across Versions

A comparison of Stockhausen's schematic of layer density patterns with our analysis of superimposition patterns and techniques reveals a number of salient correlations. Only Canon structures, which are spread across groups one to four, do not correlate with any specific group of Stockhausen's superimposition patterns.

Stockhausen's schematic of layer density patterns explains the usage and allocation of different superimposition patterns across Versions, but it does not provide a meaningful understanding of the functionality of all the patterns and techniques in use. And while our analysis of superimposition patterns and techniques elucidates this important functional aspect, it does not offer a systematic method of allocation. Thus, Stockhausen's sketch of layer density patterns and our analysis complement each other, creating a vital bridge towards the comprehension of electronic form in *Solo*.

Conclusion

Stockhausen systematically allocates a set of logically and musically conceived superimposition patterns across Versions, and these patterns, along with a range of superimposition techniques, generate the subdivisions of form within *Solo*. Complete cycle superimpositions patterns, which include accumulation, cyclical canons, and drones, formally define cycles; cadential chordal blocks and electronic rests punctuate these formal boundaries, while both structural and cadential chordal blocks carry out the function of densely recapitulating material; and superimposition techniques, including partial cycle superimposition patterns, deaccumulation, static layer density, delayed canons, and various non-recurring techniques, act to unify cycles and delineate further subdivisions of form.

Stockhausen abandons the traditional exposition/development/recapitulation paradigm for a new conception of form, a ‘memory’ form involving an interaction of acoustic and electronic feedback. *Solo* could be considered thematically non-developmental, but I contend that Stockhausen achieves a different type of development: a development through structure, texture and diffusion which amalgamates these traditional elements of form, thus creating a continuous, temporally displaced exposition/development/recapitulation structure. Stockhausen strove for, and achieved, ‘something new’ in the composition of *Solo*; although his original intentions underwent a transformation in which the idea of a ‘structure formation’ takes on a new meaning, the kernel of Stockhausen’s idea persists in the manifestation of electronic superimpositions. Today, *Solo* occupies a seminal position in the repertoire of live electronic music involving the recording, playback, and processing of sound from an instrumentalist(s) during concert performance.

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Recordings

Vinko, Globokar (trombone). Vinko Globokar: *Discours II*, Luciano Berio: *Sequenza V*, Karlheinz Stockhausen: *Solo, für Melodie-Instrument mit Rückkopplung*, Carlos Roqué Alsina: *Consecuencia*, Hamburg: Deutsche Grammophon Gesellschaft, "Avant Garde", Vinyl, LP recording, 104 992, 1969, compact disc.

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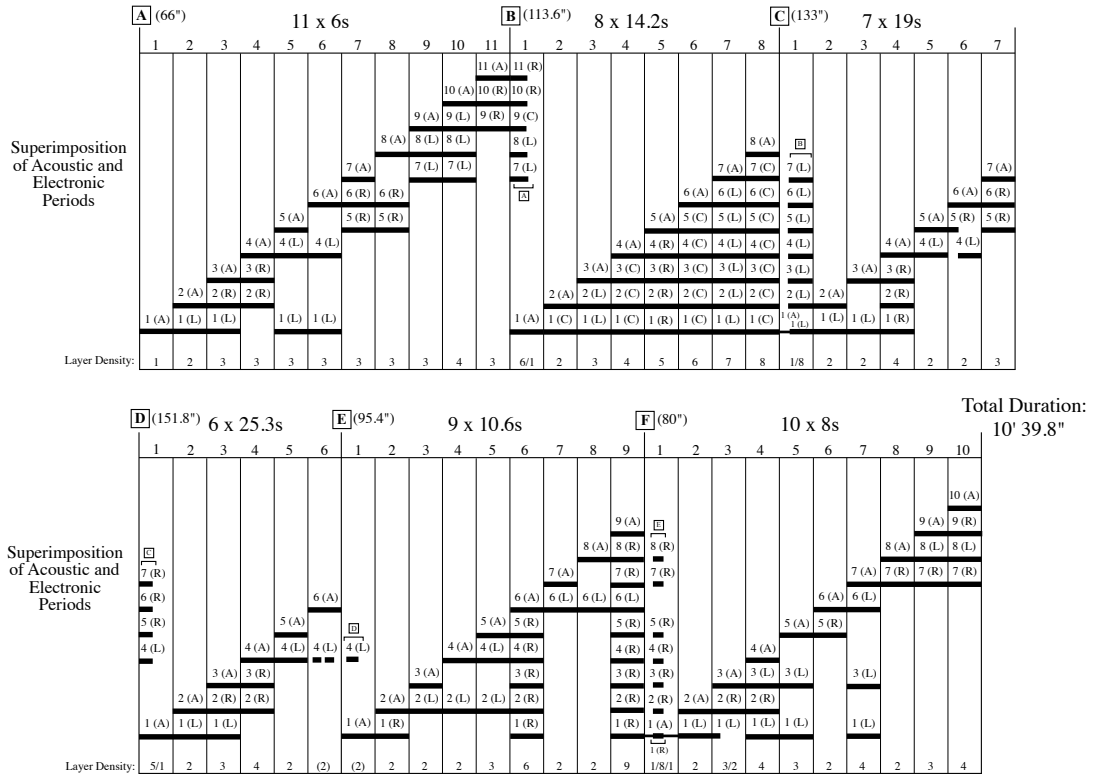
Appendix I

Acoustic/Electronic Superimpositions Graphs

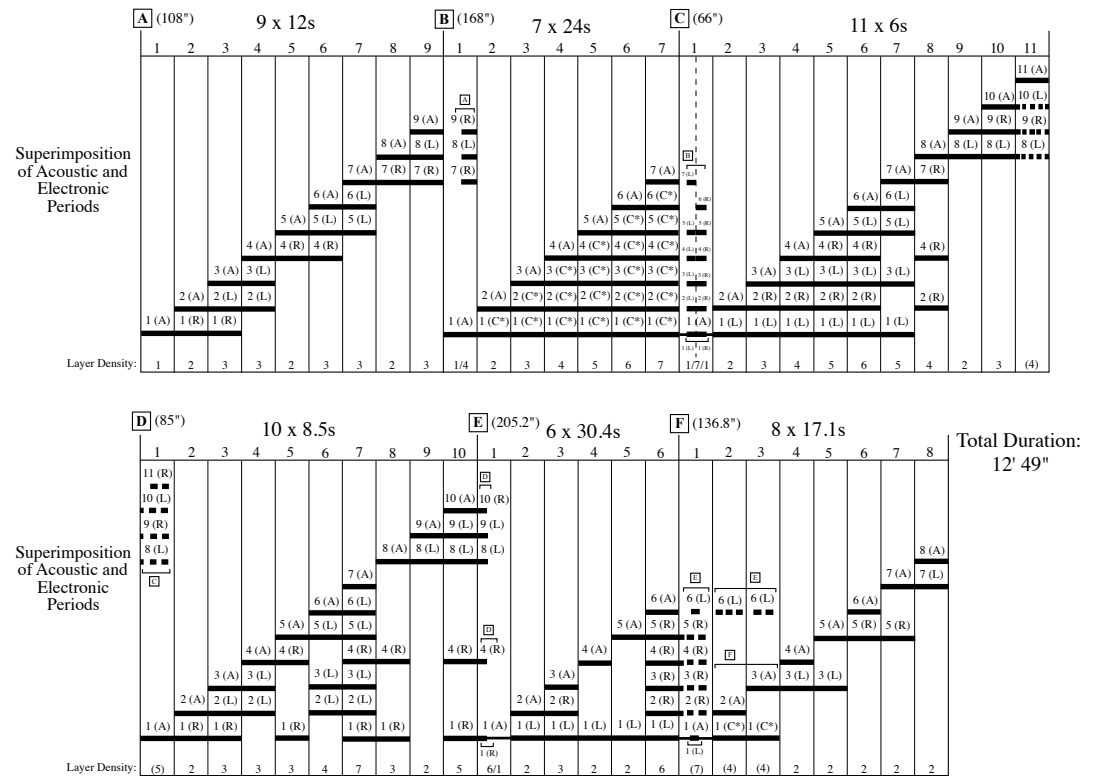
Abbreviations

- A = Acoustic (Live sound of the instrumentalist)
- L = Left (Electronic Superimposition originating from Channel I)
- R = Right (Electronic Superimposition originating from Channel II)
- C = Centre (Electronic Superimposition originating from Channel I and II)
- C* = Centre (Intermittent output from Channels I and II)

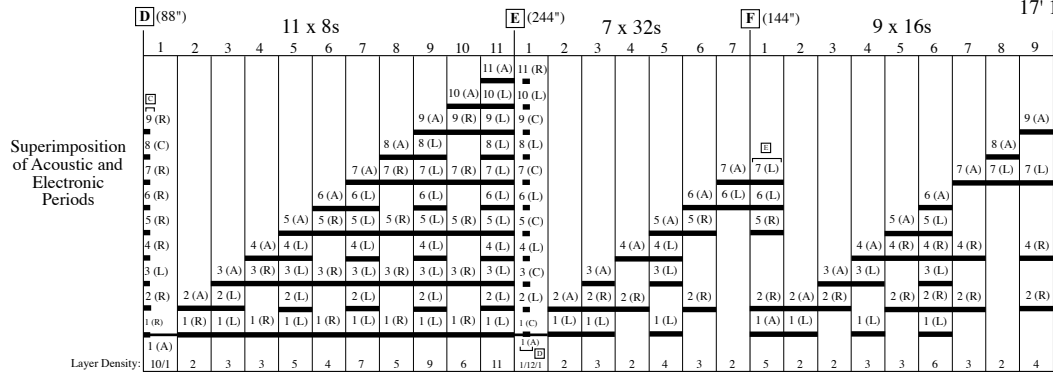
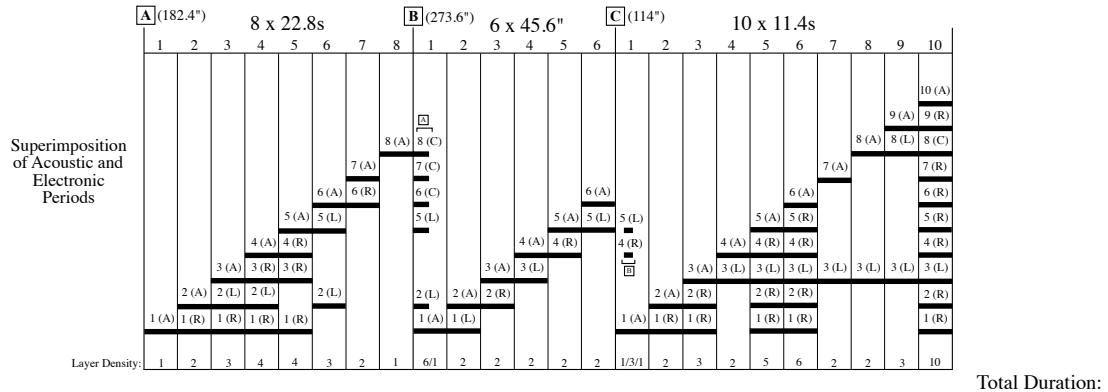
Acoustic/Electronic Superimposition Graph: Form Scheme Version I



Acoustic/Electronic Superimposition Graph: Form Scheme Version II



Acoustic/Electronic Superimposition Graph: Form Scheme Version V



Acoustic/Electronic Superimposition Graph: Form Scheme Version VI

